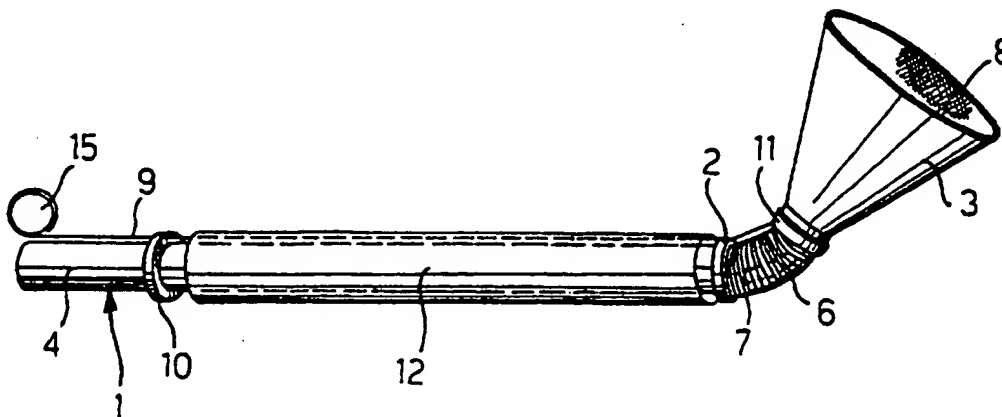




## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<b>(21) International Application Number:</b> PCT/EP97/00289 <b>(22) International Filing Date:</b> 22 January 1997 (22.01.97) <b>(30) Priority Data:</b> TO96A000033 23 January 1996 (23.01.96) IT <b>(71)(72) Applicants and Inventors:</b> GENTILLI, Sergio [IT/IT]; Via San Fermo, 3, I-10100 Torino (IT). VELARDOCCHIA, Mauro [IT/IT]; Via Principe Tommaso, 5, I-10100 Torino (IT). <b>(72) Inventor; and</b> <b>(75) Inventor/Applicant (for US only):</b> BELFORTE, Guido [IT/IT]; Via Bibiana, 50, I-10100 Torino (IT). <b>(74) Agents:</b> BUZZI, Franco et al.; Buzzi, Notaro & Antonielli d'Oulx S.r.l., Corso Fiume, 6, I-10133 Torino (IT).		<b>(81) Designated States:</b> AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG). Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM). European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).  <b>Published</b> <i>With international search report.</i> <i>With amended claims.</i>

**(54) Title:** LAPAROSCOPIC INSTRUMENT FOR HANDLING PARENCHYMATOUS AND CAVUM ORGANS

**(57) Abstract**

A laparoscopic-endoscopic surgical instrument for grasping and handling parenchymatous and cavum organs, comprising a rigid tube (1), a suction cup (3) provided at the proximal end (2) of the tube (1), and a vacuum source (5) to be connected to the distal end (4) of the tube (1) so as to enable the suction cup (3) to be applied against and adhere to the organ (C). The suction cup (3) is pivotally connected to the proximal end (2) of the tube. Accordingly, the suction cup (3) can be oriented relative to the axis of the tube (1).

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## LAPAROSCOPIC INSTRUMENT FOR HANDLING PARENCHYMATOUS AND CAVUM ORGANS

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Field of the invention

The present invention is related to a surgical instrument intended to grasp and handle parenchymatous and cavum organs of the human and animal body in laparoscopic and endoscopic surgery.

The laparoscopic surgery, as regards the general surgery, appeared for the first time in 1987 when, in Lion, Philippe Mouret made the first colecistectomy by celioscopic way. No surgical technique has ever imposed in such a short time and with a so generalized consent, widening the surgeon's interest beyond the removal of bilious vesicle only (currently already entered the clinical practice), and thus extending to abdominal closed sky surgery. Nowadays it is generally recognised that this surgical technique aims to reproduce gestures, modes and objectives of the traditional surgery, only differing therefrom as far as the mini-invasive access is concerned.

State of the the prior art

The surgical instruments currently employed for such a technique, though specially designed for passage across the small cutaneous accesses, do not adjourn substantially from the traditional surgical instruments. Particularly as regards the exposure of the operating field, grasping pliers and retractors are generally employed to firmly grab, displace or put under traction the organs (endo-Bebcock, ring pliers, Duval, toothed pliers, etc.). The common feature of all these instruments is the provision of a bite system that makes them unsuitable for anatomical structures which are unable to bear this kind of grasp. To spread apart and put these structures under tension palpators, cylindrical pipes or digital retractors are currently used, which however are unable to perform grasping since only capable to displace the viscera.

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A surgical instrument specifically intended to taking hold of and/or displacing tissues and/or organs, particularly during endoscopic surgery, is disclosed in US-5,196,003 assigned to Ethicon, Inc. The solution contemplated in this prior reference consists of a tube axially placed within a cannula, with its proximal and distal ends emerging therefrom. The tube proximal end is provided with a flexible suction cup in the form of a concave cup having a central orifice, while the tube distal end is provided with a hollow bulbe communicating with the orifice of the suction cup. This bulbe is manually operable so as to apply the suction cup under vacuum onto the organ to be held and/or displaced. Since the tube, the suction cup and the bulbe are generally made as a single piece, the suction cup is practically rigidly fixed to the tube, thus without any capability of relative displacement. This involves serious risks of traumatising, in use, the organs when grasped and handled.

#### Summary of the invention

The object of the present invention is to overcome the drawbacks of the prior art, and to provide a surgical instrument, specifically intended for laparoscopic and endoscopic surgery, which can afford effective holding of the organ while safely ensuring integrity thereof.

This object is achieved primarily by a laparoscopic-endoscopic surgical instrument for grasping and handling parenchymatous and cavum organs, comprising a rigid tube having an axis, a proximal end and a distal end, a suction cup provided at the proximal end of the tube and having a central aperture communicating with said tube, and vacuum source means to be connected to the distal end of the tube so as to enable the suction cup to be applied against and adhere to said organs, characterized in that the suction cup is pivotally connected to the proximal end of the tube so that said suction cup can be oriented relative to the axis of said tube.

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According to a preferred embodiment of the invention, the tube has a flexible section between its proximal end and the suction cup, and stay wire means, axially extending along the tube and operable at the distal end thereof, may be connected to the suction cup so as to control orienting thereof.

Additionally, the suction cup may conveniently have an anti-slip inner surface.

#### Brief description of the drawings

Further features and advantages of the invention will become apparent from the following detailed description of a preferred embodiment, with reference to the accompanying drawings, purely provided by way of non limiting example, in which:

- figure 1 is a diagrammatic perspective view of a surgical instrument according to the invention, shown during operation,
- figure 2 is a diagrammatic perspective view of the instrument prior to operation,
- figure 3 is a variant of figure 2,
- figure 4 is a variant of figure 1,
- figure 5 shows the instrument of figure 4 in a different configuration, and
- figure 6 is a further variant of figure 1.

#### Detailed description of preferred embodiments

Figure 1 diagrammatically depicts a surgical instrument intended to grasp and handle a cavum organ C of the human or animal body in laparoscopic and endoscopic surgery.

The instrument essentially comprises a rigid tube 1 provided at its proximal end 2 with a suction cup 3 and adapted to be connected at its distal end 4 to a vacuum source. The vacuum source is preferably consisting of an external controllable vacuum equipment, not shown in the drawings, for instance connected to the distal end 4 of the tube 1 through a hose 5. Alternatively, the vacuum source may comprise a manually operable resilient bulb secured to the distal end 4, such as disclosed in US-5,196,003.

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According to the primary feature of the invention, the suction cup 3 is connected to the proximal end 2 of the tube in a pivotal or tiltable fashion, and is thus capable to be oriented relative to the axis of the tube 1. To this effect, a flexible section 6 of the tube 1 is provided between its proximal end 2 and the suction cup 3. This flexible section 6 may be resiliently deformable so as to hold, and in its undeformed condition, the suction cup 3 in a coaxially-aligned condition relative to the duct 1.

In order to prevent collapsing of the resilient section 6 upon tilting of the suction cup 3, a resilient means may further be operatively associated to the flexible section 6, also contributing to urge the suction cup 3 towards its undeformed condition. As shown in figure 4, this resilient means may for instance comprise a helical spring 7 coaxially arranged outside(or inside) the flexible section 6. Alternatively, the resilient means may be formed by a corrugated member integral with section 6.

The suction cup 3, which is conveniently also made of a resilient material, has a generally conical surface and an annular construction. Accordingly, the inner end of the suction cup 3 defines an aperture communicating the interior thereof with the flexible section 6 and, therefore, with the tube 1 and the vacuum source connected to the distal end 4 thereof.

According to a further feature of the invention, the suction cup 3 has an anti-slip inner surface 8, for instance formed with knurlings. It is to be pointed out that these knurlings are not formed continuously over the entire inner surface 8, but they are more conveniently provided at discrete locations thereof, as shown in the drawings, for instance on different alternated planes.

In general, the suction cup 3 shall have a circular cross section. However, in particular cases, the suction cup 8 may have a different design, such as a flat cross section as diagrammatically depicted in figure 6, or even a variable-generatrix design. Moreover, the suction cup may

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have a double-wall construction, formed by an outer wall communicating with the tube 1 (and, therefore, with the vacuum source), and by a closed inner wall defining the inner surface 8. Accordingly, should the suction cup 3 accidentally detach during operation from the organ held thereby, no air or liquid would be sucked through the tube 1.

In order to perform tilt orienting of the suction cup 3 relative to the tube 1 a stay wire system may be provided, such as diagrammatically depicted in figure 4 and 5. This system comprises one (or more) stay wire 9 axially extending along the tube 1 and slidably fitted through outer guides 10 thereof. The stay wire 9 has one end secured to an outer ring 11 fixed to the suction cup 3, and its other end is manually operable at the distal end 4 of the tube 1 so as to tilt and orient the suction cup 3 as desired, for instance to the angled position (relative to the axis of tube 1) depicted in figure 5. Operation of the stay wires 9 may also be carried out by shown in the drawings means of a rotary screw-and-nut device, diagrammatically shown as 15 in figures 4 and 5, provided at the distal end 4 of the tube 1.

Reference numeral 12 designates, in figures 2 through 5, a tutor duct adapted to house therein, in an axially slidable fashion, the tube 1 and the suction cup 3 in a contracted condition, for assisting like a guide insertion of the instrument through the body, towards the organ C. Following insertion, the instrument is then moved axially relative to the tutor duct 12 until the suction cup 3 is exposed thus returning to its undeformed expanded condition of figure 1. To this end, the suction cup 3 may further be provided with resilient inner or outer bars 13 (figure 1) designed to urge towards and maintain the suction cup 3 in its undeformed expanded condition when same is extracted relative to the tutor duct 12.

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Figure 3 shows a further embodiment employing a trocar device 14, generally known per se, through which the tutor duct 2 is axially slidably guided.

In use, upon proper positioning of the instrument with the aid of the tutor duct 12 and possibly of the trocar device 14, the suction cup 3 is brought into contact with the organ C to be taken hold, while simultaneously suction is applied within the cup 3. Due to the unique features disclosed in the above, and namely to the capability of orienting the suction cup 3 relative to the tube 1, any trauma of the organ C being taken hold of and handled is safely prevented.

Release of the suction cup 3 relative to the organ C is simply performed by removing vacuum.

The surgical instrument according to the invention may further comprise a valve (not shown in the drawings since of a generally conventional type) operable to apply vacuum from the vacuum source to the suction cup 3 only after the latter is brought into contact with the organ C to be handled. A check valve (not shown in the drawings since also of a generally conventional type) may also be provided between the suction cup 3 and vacuum.

Naturally the details of construction and the embodiments may be widely varied with respect to what has been disclosed and illustrated, without thereby departing from the scope of the present invention, such as defined in the appended claims. Thus, for instance, orienting of the suction cup 3 relative to the tube 1 might be carried out, instead of through the flexible section 6, providing a hollow universal joint or equivalent device therebetween.



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CLAIMS

1. Laparoscopic-endoscopic surgical instrument for grasping and handling parenchymatous and cavum organs, comprising a rigid tube (1) having an axis, a proximal end and a distal end (4), a suction cup (3) provided at the proximal end (2) of said tube (1) and having a central aperture communicating with said tube (1) and vacuum source means (5) to be connected to said distal end (4) of said tube so as to enable said suction cup (3) to be applied against and adhere to said organs (C), characterized in that the suction cup (3) is pivotally connected to the proximal end (2) of said tube (1) so that said suction cup (3) can be oriented relative to the axis of said tube (1).
2. Surgical instrument according to claim 1, wherein said tube (1) has a flexible section (6) between said proximal end (2) thereof and said suction cup (3).
3. Surgical instrument according to claim 2, further comprising stay wire means (9) connected to said suction cup (3), axially extending along the tube (1), and operable at the distal end (4) of said tube (1) to control orienting of said suction cup (3).
4. Surgical instrument according to claim 2, further comprising actuator means (15) at the distal end (4) of said tube (1) for operating said stay wire means (9).
5. Surgical instrument according to claim 2, wherein said flexible section (6) is resiliently deformable.
6. Surgical instrument according to claim 2, further comprising resilient means (7) operatively associated to said flexible section (6) and urging said suction cup (3) towards a coaxially-aligned condition thereof relative to said tube (1).

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7. Surgical instrument according to claim 6, wherein said resilient means comprise a helical spring (7) coaxial with said flexible section (6) and preventing collapsing thereof.

8. Surgical instrument according to claim 1, wherein said suction cup (3) has an anti-slip inner surface (8).

9. Surgical instrument according to claim 8, wherein said inner surface (8) of the suction cup (3) is formed with anti-slip knurlings.

10. Surgical instrument according to claim 9, wherein said knurlings are provided at discrete locations of said inner surface (8) of the suction cup (3).

11. Surgical instrument according to claim 1, wherein said suction cup (3) has a generally conical inner surface (8).

12. Surgical instrument according to claim 1, wherein said suction cup (3) has a flat cross section.

13. Surgical instrument according to claim 1, wherein said suction cup (3) has a double-wall construction.

14. Surgical instrument according to claim 1, further comprising valve means operable to apply vacuum from said vacuum source means (5) to the suction cup (3) only after said suction cup (3) is brought into contact with the organ (C) to be handled.

15. Surgical instrument according to claim 1, further comprising check valve means between said suction cup (3) and said vacuum source means (5).

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16. Surgical instrument according to claim 1, further comprising a tutor duct means (12) within which said tube (1) with said suction cup (3) is axially slidably fitted.

17. Surgical instrument according to claim 16, wherein said suction cup (3) is elastically deformable and further comprising return means (13) urging said suction cup (3) to an undeformed condition when said suction cup (3) is extracted relative to said tutor duct (12).

18. Surgical instrument according to claim 16, further comprising trocar means (14) within which said tutor duct means (12) is axially slidably fitted.

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## AMENDED CLAIMS

[received by the International Bureau on 6 June 1997 (06.06.97);  
original claims 1-18 replaced by amended claims 1-16 (3 pages)]

1. Laparoscopic-endoscopic surgical instrument for grasping and handling parenchymatous and cavum organs, comprising a rigid tube (1) having an axis, a proximal end and a distal end (4), a suction cup (3) provided at the proximal end (2) of said tube (1) and having a central aperture communicating with said tube (1) and vacuum source means (5) to be connected to said distal end (4) of said tube so as to enable said suction cup (3) to be applied against and adhere to said organs (C), said tube (1) having a flexible section (6) between said proximal end (2) thereof and said suction cup (3) and said suction cup (3) being pivotally connected to the proximal end (2) of said tube (1) via said flexible section so that said suction cup (3) can be oriented relative to the axis of said tube (1), characterized in that it further comprises a resilient member (7) operatively associated to said flexible section (6) and urging said suction cup (3) towards a coaxially-aligned condition thereof relative to said tube (1).
2. Surgical instrument according to claim 2, wherein said resilient member comprises a helical spring (7) coaxial with said flexible section (6) and preventing collapsing thereof.
3. Surgical instrument according to claim 1, further comprising stay wire means (9) connected to said suction cup (3), axially extending along the tube (1), and operable at the distal end (4) of said tube (1) to control orienting of said suction cup (3).
4. Surgical instrument according to claim 3, further comprising actuator means (15) at the distal end (4) of said tube (1) for operating said stay wire means (9).

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5. Surgical instrument according to claim 1, wherein said flexible section (6) is resiliently deformable.
6. Surgical instrument according to claim 1, wherein said suction cup (3) has an anti-slip inner surface (8).
7. Surgical instrument according to claim 6, wherein said inner surface (8) of the suction cup (3) is formed with anti-slip knurlings.
8. Surgical instrument according to claim 7, wherein said knurlings are provided at discrete locations of said inner surface (8) of the suction cup (3).
9. Surgical instrument according to claim 1, wherein said suction cup (3) has a generally conical inner surface (8).
10. Surgical instrument according to claim 1, wherein said suction cup (3) has a flat cross section.
11. Surgical instrument according to claim 1, wherein said suction cup (3) has a double-wall construction.
12. Surgical instrument according to claim 1, further comprising valve means operable to apply vacuum from said vacuum source means (5) to the suction cup (3) only after said suction cup (3) is brought into contact with the organ (C) to be handled.
13. Surgical instrument according to claim 1, further comprising check valve means between said suction cup (3) and said vacuum source means (5).
14. Surgical instrument according to claim 1, further comprising a tutor duct means (12) within which said tube (1) with said suction cup (3) is axially slidably fitted.

15. Surgical instrument according to claim 14, wherein said suction cup (3) is elastically deformable and further comprising return means (13) urging said suction cup (3) to an undeformed condition when said suction cup (3) is extracted relative to said tutor duct means (12).

16. Surgical instrument according to claim 14, further comprising trocar means (14) within which said tutor duct means (12) is axially slidably fitted.

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Fig. 1

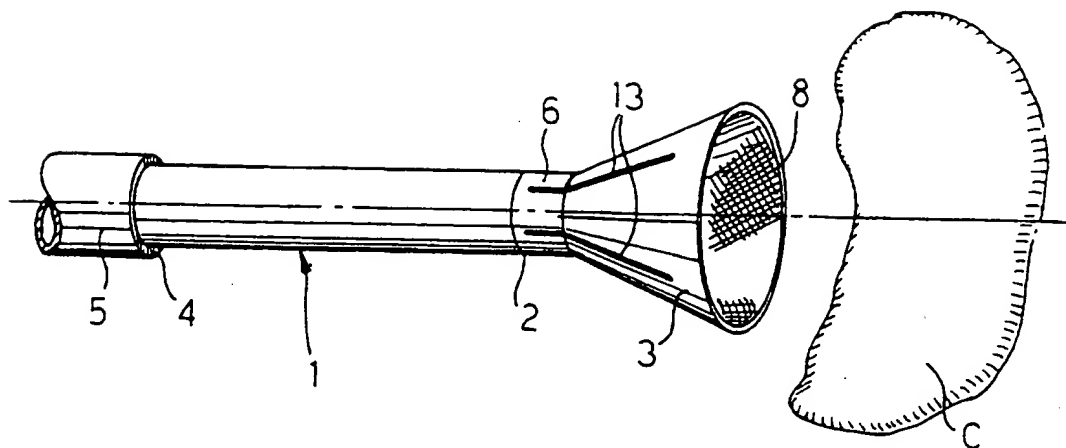


Fig. 2

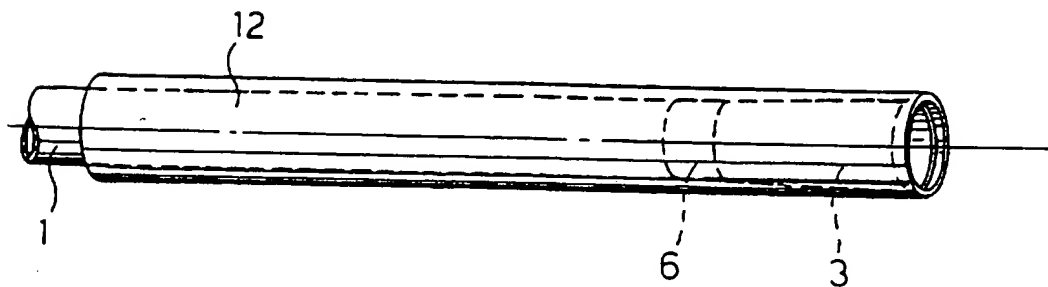
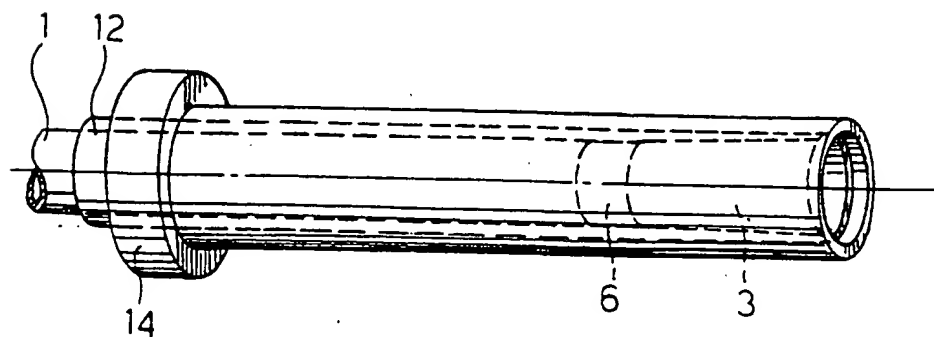
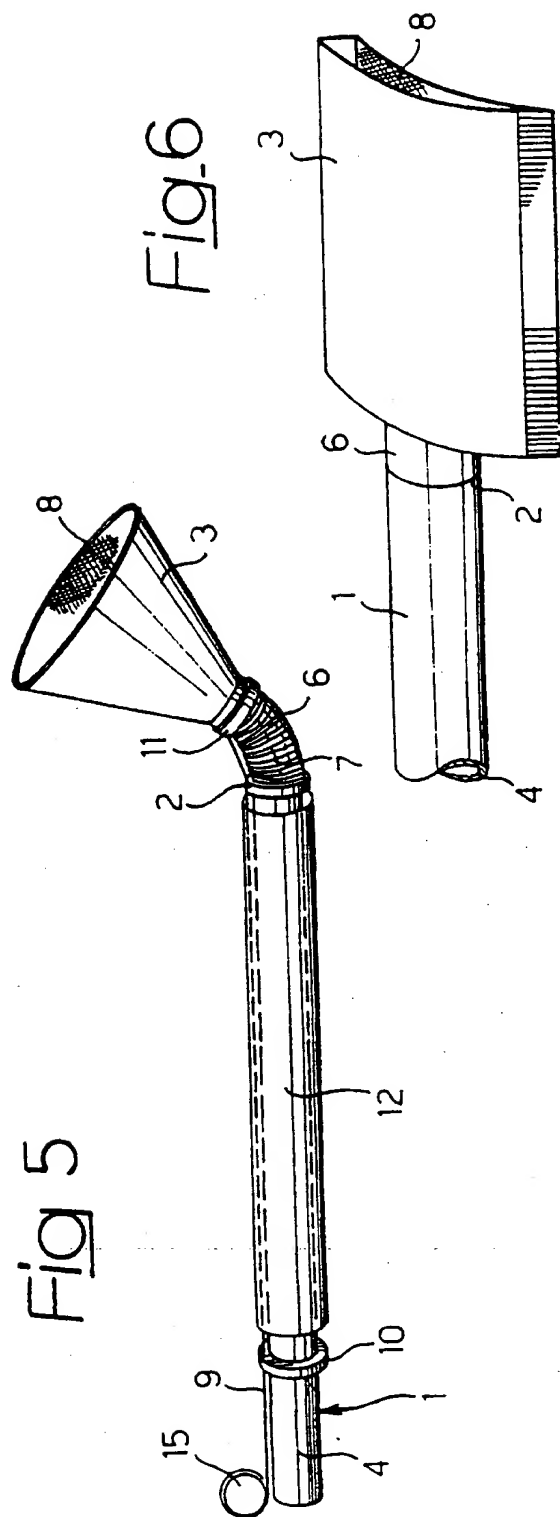
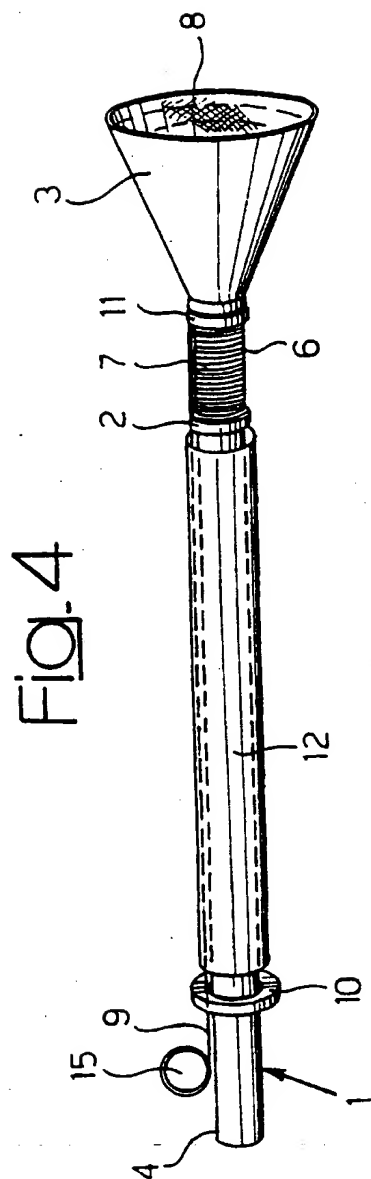


Fig. 3







# INTERNATIONAL SEARCH REPORT

International Application No.

PCT/EP 97/00289

A. CLASSIFICATION OF SUBJECT MATTER  
IPC 6 A61B17/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
IPC 6 A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 95 32011 A (YOON INBAE) 30 November 1995 see page 31, line 28 - line 33 see page 49, paragraph 1 see page 53, paragraph 3 see page 54, line 31 - line 34; figure 27 ---	1-18
A	US 5 423 830 A (SCHNEEBAUM CARY W ET AL) 13 June 1995 see column 2, line 53 - line 59 ---	1
A	US 5 279 548 A (MITCHELL N. E.) 18 January 1994 see column 3, line 60 - column 4, line 9 -----	15

☐ Further documents are listed in the continuation of box C.

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Date of the actual completion of the international search

2 April 1997

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# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/EP 97/00289

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